IES Newsletter

Volume 8, Number 1
January - February 1991

Director's Note

The Institute of Ecosystem Studies relies on funding from private and public sources for its research and ecology education programs.

Through its research grants, the Andrew W. Mellon Foundation has contributed in a major way to the success of the Hubbard Brook Ecosystem Study. In this issue of the IES NEWSLETTER you will learn that this support will continue, and that the foundation also will provide the means to begin important research in the area of soil microbial ecology. In addition, the General Reinsurance Corporation will fund long-term monitoring studies at IES related to several critical environmental problems. This issue's cover story describes how a five-year grant from the Lila Wallace-Reader's Digest Fund will expand research, management and education programs at The New York Botanical Garden Forest, and on Page 2 you will read of a one-year study of cloud water deposition funded by the National Science Foundation (NSF). NSF has also awarded the Institute a grant that will pave the way for the nationwide use of the Eco-Inquiry curriculum in elementary school classrooms; an article featuring this will appear in the March-April issue.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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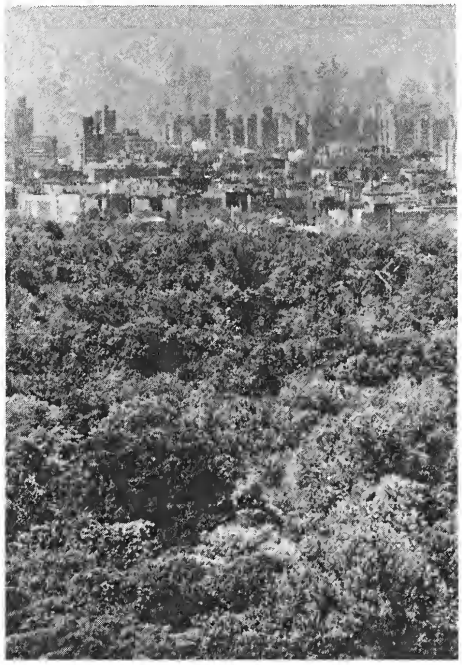
New Work in an Old Forest

During the settlement of the Northeast, much of the primary forest was cleared for villages and farms. As a result, the majority of our woodlands, except in the remotest of areas, are secondary growth forests. One would expect this to be the case especially throughout the approximately 2,500 hectares (over 6,000 acres) of forests in the five boroughs of New York City . . . but one would be wrong. The New York Botanical Garden Forest in the Bronx—16 hectares (40 acres) bordered by the Bronx River—has never been cut.

This is not to say that the forest has not been subjected to other types of disturbance. Pollution levels are high. The forest is exposed to acid rain that has even lower pH level[1]— averaging 3.8 to 4.0—than levels in other parts of the Northeast. Toxic metals, such as lead, are present in the forest soil in amounts that are five to ten times greater than those in rural areas. Some soils are hydrophobic—rainwater beads up on the surface rather than soaking in—and it is hypothesized that pollutants may be the cause of this peculiar phenomenon. In addition, over the nearly 100 years that the forest has been open to the public, the impact of humans has been great. The large number of people enjoying the forest has led to the trampling of seedlings and to soil erosion. Vandalism also has been a problem.



TED SPIEGEL

The New York Botanical Garden Forest, with the Manhattan skyline as a backdrop.

The forest needed to be protected and managed, and at the same time developed as a field site for education and research. In 1984, the Institute of Ecosystem Studies began The New York Botanical Garden Forest Project, with IES terrestrial ecologist Dr. Mark J. McDonnell and Director Dr. Gene E. Likens as principal investigators. Funded by annual grants from the Lila Wallace-Reader's Digest Fund, the project had three major goals: 1) to collect baseline data on plants, animals, soil and water in order to assess the health of the forest; 2) to develop ecologically sound management techniques; and 3) to develop and produce educational materials to inform the public of the importance of proper care of urban forests.

The Lila Wallace-Reader's Digest Fund has just demonstrated its long-term commitment to the goals of the NYBG Forest Project by awarding a five-year grant in support of both the expansion of established programs and the development of new ones.

New Programs

Dr. McDonnell has three major objectives as this new phase of work in the NYBG Forest begins. Through research, he hopes to gain a better understanding of the role of non-native tree species in forest regeneration and nutrient cycling. The trees in question, all introduced ornamentals that have "escaped", include the tree of heaven, Norway maple, Amur cork tree and princess tree. These species are regenerating more quickly than are the native trees in the NYBG Forest—hemlock, oak, birch, maple and cherry. In the area of education, Dr. McDonnell hopes to increase visitor awareness of the vulnerability of the urban forest ecosystem and to maintain the public areas in such a way that they command respect and discourage vandalism.

With additional resources for management, Edward A. Roy, NYBG Forest manager, not only can continue to maintain the trails, signs and scenic overlooks that already have been restored but also will be able to restore secondary trails and begin the revegetation process on severely eroded slopes. Finally, urban natural areas are extremely important for maintaining local biological diversity, in spite of the fact that

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[1] *The logarithmic pH scale indicates a degree of acidity or alkalinity. On the scale of 0-14, neutral is 7.0; ammonia, a base, has a pH of approximately 11.0, and vinegar, an acid, has a pH of approximately 3.0. The lower the pH value, the higher the acidity. The pH of "normal" rain is 5.6 or higher, while acid rain values range from approximately 5.0 down to 2.0 (the pH of lemon juice).*

Dr. Lovett Collects Cloud Water in a Cloud Forest

One of the first things children learn about nature is that after rainwater sinks into the soil it is taken up by plants' root systems. This, however, is not the only relationship between rainwater and plants. Leaves absorb water too, and nutrients such as nitrogen and phosphorus that are naturally present in rainwater enter leaves in this way. In addition, excess amounts of other chemicals, for example potassium, are harmlessly leached away by water passing over leaf surfaces.

It is now known that the moisture in clouds—moisture distinct from rainwater—is also an important source of nutrients and water to certain forests, especially those on mountaintops that frequently are immersed in clouds. What is not known are the relationships between density of the forest canopy (the uppermost layer of foliage), the amount of cloud water intercepted by the canopy, and the chemistry of the water that drips through to the forest understory. These relationships have interested Dr. Gary M. Lovett, an IES plant ecologist studying the atmospheric deposition of nutrients and pollutants to forests, but they have been difficult to study in the field. An ideal research site—a mature forest where changes in water chemistry could be measured throughout canopy development from a leafless to a dense condition—is difficult to find.

In fall 1989, however, Hurricane Hugo helped. This major storm passed directly over the island of Puerto Rico, leaving the short, wind-adapted trees in the higher mountain cloud forests standing but stripped of their leaves and epiphytic plants (mosses, bromeliads etc.). In spite of this the trees remained alive, and regrowth of the leaves was expected to be relatively rapid in the tropical environment. Dr. Lovett learned of this fortuitous combination of conditions from Dr. Clyde Asbury, a former graduate student of IES Director Dr. Gene E. Likens who is now working at the Center for Energy and Environmental Research in San Juan, Puerto Rico. After discussing their mutual interest in the question of atmospheric deposition to the cloud forest, Drs. Lovett and Asbury sought funding from the National Science Foundation to see if an answer could be found. The request was approved, and a one-year research project began in spring 1990.

The research site is just below the summit of Pico del Este, a 1050 meter (3,445 ft.) mountain in the Caribbean National Forest southeast of San Juan; this location is not far from one of the Cloud Water Project* sampling sites, so there was already baseline data available on local cloud water chemistry. Above the canopy, rainwater is collected in a funnel and cloud droplets are collected in a harp-like cloud water collector exposed to the prevailing wind. The water that drips through the canopy and down the trees is collected by funnels under the canopy and by collars around tree trunks.

MAYRA TORO

Dr. Lovett stands by the tower that holds meteorological equipment and rain and cloud samplers. The natural forest canopy in the Puerto Rican cloud forest is wind-adapted—note its short stature.

Mayra Toro, a student at the Interamerican University of Puerto Rico (and a participant in the 1990 IES Research Experiences for Undergraduates Program; see IES NEWSLETTER, Volume 7 Number 4), is the research assistant on the project. Each week, on three consecutive days, she travels from a nearby field station to the research site to empty the collectors, record the amounts of rain and cloud water collected, and perform some preliminary analyses of the samples. She then sends the samples to the IES labs where research assistants Denise Schmidt, Carmen Santos and Ken Kinder measure concentrations of nutrients and other chemicals. By comparing the amounts of chemicals and water that drip through the canopy to the amounts deposited in the rain and cloud water collectors, Drs. Lovett and Asbury hope to be able to determine the amount of cloud deposition to the forest and the chemical changes imparted by the forest canopy as the water drips through it.

Since leaves and epiphytes were only beginning to grow back on tree branches and trunks when the study began, they offered only minimum surface area to intercept droplets of moisture. Consequently, nutrient deposition by cloud water was at a minimum. Now, as the leaves and epiphytes grow back, the ecologists expect to see an increase in the amount of cloud water deposition to the forest. After a year of measurements they will know the rate of deposition and the changes in the chemistry of the water as it passes over the natural "filters" on branches and trunks. This information will help them determine the rate at which cloud water deposition supplies water and nutrients to these cloud-adapted forests. At the same time, they will be studying the response of this forest to a major natural disturbance.

Another question addressed by this research is one that has been considered in a computer model but has yet to be tested in nature: Does cloud water deposition peak as leaves begin to grow back, then decrease when the forest canopy becomes very densely foliated? The computer model suggests that it will, and Dr. Lovett hypothesizes that this could be because wind would blow the clouds over, rather than through, the dense layer of foliage. Perhaps, through long-term observations, this question also will be resolved.

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* *The Cloud Water Project, coordinated by Kathleen C. Weathers at IES, measured the phH and chemistry of cloud water at 10 sites from Alaska to Puerto Rico for two years in the mid-1980s. The data showed that chemicals in cloud water are more concentrated than they are in precipitation from the same location.*

Membership

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, a free subscription to the IES NEWSLETTER, and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is $30; family membership is $40. For membership information contact Janice Claiborne at (914) 677-5343.

Grants Support Continuing Studies and New Research

With the goal of further increasing its contribution to ecosystem science, the Institute of Ecosystem Studies applied for funding to continue research that is part of the Hubbard Brook Ecosystem Study (HBES), to begin studies of soil microbial ecology and to initiate long-term monitoring of critical environmental problems. It was announced recently that grants from the Andrew W. Mellon Foundation and the General Reinsurance Corporation will provide support in these research areas.

The Andrew W. Mellon Foundation first supported the HBES with exploratory studies of acid rain in 1980. The HBES, located in the U.S.D.A. Forest Service Hubbard Brook Experimental Forest in the White Mountains of New Hampshire, was begun in 1963 when IES Director Dr. Gene E. Likens (then with Dartmouth College) and three scientific colleagues wondered if the chemistry of stream water might reflect the status of a surrounding forest. Since then, the major objective of the study has been to understand better the ecology of the forest and its associated stream and lake ecosystems. Important discoveries have resulted from the long-term studies as part of the HBES, among them the documentation of acid rain in North America. The recent Mellon Foundation grant ensures that the Hubbard Brook Valley will continue to be one of the most intensely studied places on Earth, providing baseline date against which environmental change can be measured for decades to come.

The Mellon Foundation is also supporting a new research initiative at IES: soil microbial ecology. Ecosystem studies require a knowledge of interactions among the atmosphere, water and Earth's crust. A key site of these interactions is soils, where both nutrients and toxic material from pollution are transformed by biological and chemical interactions and are transported by ground and surface waters. Soils are also a key site of ecological interactions—among microbes, among plants, among soil animals, and among the groups themselves—for food and water. Therefore, soils are of fundamental importance to living systems and it is necessary to understand soil processes as a component of ecosystem studies. The newly-funded initiative in soil microbial ecology will complement and enhance existing IES expertise.

In the northeastern United States, we see red spruce, ash, sycamore, hemlock and sugar maple trees, among others, showing the symptoms of stress not evident a decade ago. Is this abnormal? Is it something that we humans have caused? Or are the changes part of a natural process that we have just happened to notice at this time? Because long-term ecological observations of these trees have not been made, scientists do not know the answer to these questions. The monitoring of the environment over extended periods is essential for reasons of scientific understanding and public policy formulation—ecosystem scientists armed with decades of solid data can help public officials find correct solutions to environmental problems. The recent grant from the General Reinsurance Corporation in Stamford, Connecticut will provide initial funding for long-term monitoring of gypsy moth outbreaks and declines, forest health and regional climate change. The resulting long-term data sets will be invaluable as questions arise and solutions to environmental problems are sought.

We Need Your Help . . .


SHARON M. OKADA

Do you have fun working with school children?
Do you like to be outdoors?
Would you like to learn more about ecology and then share what you know?

If you can answer *"Yes!"* to these questions, Diana Wilson invites you to become a volunteer at the IES Outdoor Science Center. Ms. Wilson, program specialist in ecology education, is planning a pond ecology program for grades 5 through 8—she needs you to help students discover the life, and threats to life, in a pond ecosystem.

The program will be held on weekdays from late April through early June. Ms. Wilson will lead a two-day volunteer training session early in April, after which the recruits will choose convenient times during the program to put their new skills to work with school groups. Please call Ms. Wilson or volunteer coordinator Su Marcy at the IES Education Program office, (914) 677-5358—they will be happy to talk with you about this volunteer opportunity.

* * * * *

IES volunteers receive benefits that include discounts in the Gift and Plant Shop, a subscription to the IES NEWSLETTER, invitations to staff events and to the annual volunteer banquet, and a free Continuing Education Program class each term (depending upon the number of hours worked).

NYBG Forest, *from page 1*

only relatively common plants and animals live there. Dr. McDonnell will be developing innovative management techniques for preserving these endangered areas and these new techniques will be applied to other natural areas in New York City as well as to parks in Boston, Washington D.C., Chicago and other U.S. cities.

How will Dr. McDonnell accomplish these new objectives? First, the Forest Project will hire new staff. Full-time field staff will be on duty to answer visitors' questions, to enforce rules and to discourage misuse of the forest. In addition, local high school and college students will be hired to work in all areas. They will maintain the trail system and assist with new trail restoration projects. They will be responsible for research that will include 1) the periodic sampling of trees, shrubs and herbaceous plants in permanently marked plots to learn how many plants die each year; 2) long-term studies of nutrient cycling in the forest; and 3) long-term studies of bird and mammal populations[2]. They will also assist NYBG Vice-President for Education John F. Reed and Director of Education Rosemary Kern in developing an ecological curriculum based on the NYBG Forest research and management programs.

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NYBG Forest, *from page 3*

Funds from the Lila Wallace-Reader's Digest Fund grant will also help with the development of an outreach program. Dr. McDonnell and his staff will work closely with the New York City Department of Parks and Recreation and Wave Hill (Bronx) to integrate research, management and education activities in the city's natural woodlands. In connection with this, they are planning workshops and symposia for Parks Department managers, teachers and professionals.

Who will benefit from these new and expanded programs? . . . Today's children, who will come away with a new ecological understanding as well as an appreciation of nature . . . Tomorrow's children, who will benefit from their parents' increased environmental awareness . . . Ecologists, who will learn more about the interrelationships between a forest ecosystem and an urban environment . . . City planners everywhere, whose exposure to findings from the NYBG Forest Project will help them maintain their own natural areas . . . And finally, immediately, the many individuals who come to the NYBG Forest to enjoy a peaceful green refuge from a busy city life.

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[2] *The NYBG Forest is historically an important birding area; in addition to song-birds, raptors—such as great horned owls and sharp-shinned hawks—and many species of waterfowl are found there. Also, there is a diversity of small mammals that includes rabbits, skunks, woodchucks, flying squirrels and shrews. Due to the presence of a recessive gene, 10 percent of the area's gray squirrel population has fur that varies in color from dark red to black.*

Winter/Spring Calendar

CONTINUING EDUCATION PROGRAM

The **spring semester** begins in early April. Classes, workshops and excursions are described in the Winter/Spring 1991 catalogue, as well as in the flier sent in early March to those on the Continuing Education Program mailing list. Copies of the spring flier are available at the Gifford House Visitor and Education Center.

SUNDAY ECOLOGY PROGRAMS

These **free public programs** begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted. Call (914) 677-5359 to confirm the day's topic.

Mar. 17: **Maple Sugar Ecology for Kids**, a walk led by Diana Wilson. *Note: Kids must be accompanied by an adult. There is a maximum of 30 participants for this program, and reservations are required in advance. Call Jill Cadwallader weekdays after March 1, at the number below.*

April 7: **An Origami "Springtime Ecosystem,"** an activity led by Jill Cadwallader.

April 21: **Winter and Spring Clues for Tree Identification**, a walk led by Dr. Alan Berkowitz.

May 5 and 19: Call Jill Cadwallader at 677-5358 to learn if programs have been scheduled.

In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.

IES SEMINARS

The Institute's program of **scientific seminars** features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Free.

Mar. 15: **Linkages Between Geothermal Processes and Stream Biogeochemistry in Volcanic Landscapes of Costa Rica**, by Catherine M. Pringle, Cornell Univ.

Mar. 22: **The Role of the Hidden Half in Forest Nutrient Cycles**, By Kristina Vogt, Yale Univ.

Apr. 5: Topic: **Biogeochemistry of Florida Lakes**. Speaker: Dr. Curt D. Pollman, Univ. of Florida at Gainesville.

Apr. 12: **Environmental Biology at NSF in the 1990s**, by Dr. Patricia A. Werner, National Science Foundation, Washington D.C.

Apr. 19: **Ecology: The Non-integrative Paradigm**, by Dr. Gary W. Barrett, Miami University, Ohio.

Apr. 26: **Field Studies of Solar UV-B Radiation Effects on Plants: Case Histories of Soybean and Loblolly Pine**, by Dr. Alan H. Teramura, Univ. of Maryland at College Park.

May 10: **The Effect of Soil Food Webs on Plant Growth**, by Dr. Elaine R. Ingham, Oregon State University, Corvallis.

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).

Think Spring! Week: March 17 - 25. Daily specials, and coupons for discounts on IES perennials.

Perennials: Divisions from the IES Perennial Garden will be available starting in mid-April. Call Su Marcy at the number below for details.

ARBORETUM HOURS

(Winter Hours: October 1 - April 30; closed on public holidays)

The **Arboretum** grounds are open Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m.

The **Gift and Plant Shop** is open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.).

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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